

**Tape-Recorded Questions from Audience Members at the Musky Meeting  
February 13, 2006 at the Hayward High School Auditorium**

**Responses from the Wisconsin Department of Natural Resources  
March 16, 2006**

A meeting to discuss muskellunge genetics and stocking issues was held at the Hayward High School Auditorium on the evening of February 13, 2006. Over 150 local anglers, guides, and business owners attended the meeting, which was sponsored by the Hayward Visitors and Convention Bureau (HVCB). Presentations illustrating different viewpoints were made by Steve AveLallemant, Northern Region Fisheries Supervisor for the Wisconsin DNR, and by Bob Benson and Larry Ramsell of the three-member citizen group calling itself the Wisconsin Muskellunge Restoration Project (WMRP) Team. Presentations were followed by a lengthy question-and-answer period. Most questions were directed to Mr. AveLallemant of the WDNR. Time constraints and a desire to maintain a positive atmosphere kept the answers friendly and brief, resulting in post-meeting interest in hearing “the rest of the story” from the DNR by many attendees. The next day, Cheryl Treland, President of the HVCB, formally requested that DNR provide more detailed responses, in writing. We agreed. On March 2 we received an audio cassette recording of the meeting from HVCB Executive Director, Linda Clifford. Audience questions are transcribed as accurately as possible below; and detailed answers to those questions are provided on behalf of the Wisconsin DNR. We were unable to avoid using some of the specialized language of aquatic ecologists and fish geneticists in our response, so a Glossary of Terms is attached. We appreciate the opportunity to further explain our beliefs and management decisions. We want Hayward area anglers, guides, and business owners to know how seriously we take their concerns and our responsibility to conserve this valuable fishery resource today and for future generations.

**Question #1 to DNR:** I’m wondering why the DNR has made the decision to redo a study that seems like all the information is there, as far as comparison of the two strains of fish. [The next line on tape could not be heard clearly, but seemed to be something like the following...] If you already know the results, why repeat a study that has already been done?

**DNR Response to Question #1:** We assume this question refers to Minnesota DNR Investigational Report 418 written by MDNR biologists Jerry Younk and Bob Strand in 1992. This was an interesting report that served its apparent purpose by justifying MDNR’s earlier decision to replace the Shoepack Lake strain with the Mississippi strain (Leech Lake fish) as a source of broodstock for statewide stocking. But the data in Report 418 fail to demonstrate superior performance of the Mississippi (MS) strain over the Lac Courte Oreilles (LCO) strain.

According to their 1992 report, Younk and Strand stocked 1,000 fingerlings of each strain into 3,100-acre Lake Waconia (near Minneapolis) on September 18, 1984. The lake was closed to musky harvest during the study. Sampling was done in 1987, 1988, 1989, and 1990 in order to compare survival and size of each strain of stocked fish during the four-year evaluation.

A total of 78 fish of the Lac Courte Oreilles (LCO) strain and 34 fish of the Mississippi strain (MS) were captured during the study, suggesting higher survival of stocked LCO fish. Table 4 in Report 418 reveals there were no significant differences in annual incremental growth in length between the two strains in four of six years, but MS fish grew more in length than LCO fish in two of six years. Table 8 (converted from metric to English) reveals that when stocked fish of both strains were first captured in comparable numbers in fall of 1987, 4 LCO males averaged 6.9 pounds and 4 MS males averaged 6.8 pounds. In spring of 1988, 10 LCO males averaged 7.0 pounds, and 3 MS males averaged 6.7 pounds. In spring of 1989, all stocked fish were five years old. At that time, 5 LCO males averaged 10.1 pounds, and 4 MS males averaged 9.2 pounds. Also, 12 LCO females averaged the same weight (12.8 pounds) as 7 MS females at age 5, though some of the LCO female weight could be attributed to developed ovaries. Stocked fingerlings from Shoepack Lake were clearly smaller than the other two strains, as 5 males averaged only 5.1 pounds and 3 females averaged only 8.0 pounds at age 5 (1989 spring sample). Only in the 1990 spring sample were MS males (12.2 pounds, 5 fish) and females (17.0 pounds, 7 fish) heavier than LCO males (11.0 pounds, 9 fish) and females (16.0 pounds, 8 fish). After this first year that sampled MS fish were found to be heavier than sampled LCO fish, the study ended; and the lake was opened to musky harvest.

It should be noted that the Minnesota DNR decided in 1982 to stock fish originating from Leech Lake into several new musky waters that were slated to become future sources of broodstock for the Mississippi strain (Jerry Younk, personal communication). MDNR stocked mostly LCO fish throughout Minnesota during 1982-1987 as they waited for the Leech Lake fish to mature (1987) in the new broodstock lakes. MDNR began stocking the Leech Lake strain in many Minnesota waters in 1987 – three years before completion of the Lake Waconia study.

In summary, LCO fish probably out-survived MS fish in Lake Waconia; and sampled LCO males were heavier than sampled MS males in the first three spring samples of a four-year post-stocking evaluation. We applaud Minnesota DNR's decision to use their native MS strain rather than switch permanently to a non-native LCO strain as the source for stocking Minnesota waters. Their decision was based upon sound principles of genetic stock conservation. And as their confirming study on Lake Waconia revealed, the Mississippi strain from Leech Lake was clearly superior to the Shoepack strain. But we don't understand the logic behind any expectation that the Wisconsin DNR should begin stocking MS fish instead of LCO fish in various lakes throughout the State of Wisconsin based upon the results of one short-term study on one Minnesota lake where the Mississippi strain did not clearly out-perform the LCO strain.

Also, we reject the bar chart presented by the WMRP Team as proof that 16 MS females in the Lake Waconia study eventually would have grown to 53 inches versus only 47 inches for 31 LCO females. That conclusion is based upon the questionable assumption that long-term growth curves initiated with only 6 years of early life data will maintain their form (trajectory) for the next 15-20 years until the projected ultimate lengths are achieved. While this is an interesting and common exercise in mathematical speculation, it is no more possible to accurately predict the form of these growth curves in the distant future than it is to predict the exact spot a Gulf hurricane will make landfall when it's still 24 hours offshore. In both cases, many factors can bend the dynamic curve one way or the other. The WMRP Team presented their bar chart as if it represented actual, measured performance differences between two musky strains in a major research study. In reality, it illustrated a speculative long-term projection based upon only the first six years of growth (in length) of 47 recaptured female fish stocked one year into one lake.

The study required to adequately compare performance between Leech Lake and Wisconsin fish has been proposed by Dr. Martin Jennings of WDNR and is scheduled to begin in fall 2006 with the paired stocking of seven lakes in the St. Croix Basin of western Wisconsin (outside the native range as we understand it today). In order to be confident in any conclusions, we must replicate this experiment by conducting it on several waters, not just one or two. We also must evaluate performance much longer than four years so we can measure the actual long-term survival, reproduction, and ultimate size attained by stocked fish, rather than speculating about such matters based upon monitoring only the first few years of life.

**Question #2 to DNR:** When we're looking at stocking different strains of fish; and you're looking at Mississippi strain fish versus what we have here... A lake in Minnesota which even Al Lindner (when he was up here) would say is probably the finest big-fish lake in North America right now – Mille Lacs – was actually a native musky lake. It has since had both Wisconsin fish put in and Mississippi or Leech Lake strain fish; and yet still produces the largest... or, the fish it does right now. So what makes putting them in Round or Couderay so bad in here if it's been done over there? Why wouldn't you be inclined to be putting them in here?

**DNR Response to Question #2:** We think it's interesting that a lake recognized by Al Lindner and other top anglers as producing more big fish than most other waters in North America just happens to contain both Mississippi strain and Wisconsin fish. According to MDNR biologist Rick Bruesewitz, only Wisconsin fish were stocked into Mille Lacs in 1984 (3,250 fish), 1985 (4,300), 1986 (2,000), and 1987 (4,400). MDNR has confirmed that many fish tagged during 1996-1998 and recaptured since that time at lengths exceeding 50 inches were Wisconsin fish stocked during 1984-1987. For example, a Wisconsin fish that was 46 inches long when tagged at age 10 in 1997 had grown to 52 inches by the time it was harvested by an angler on August 22, 2005 at the age of 18. Another Wisconsin fish that was 48 inches long when tagged at age 12 in 1996 had grown to almost 55 inches by the time it was found dead on May 26, 2000 at only 16 years of age. The first time you stock good fish into good water, they grow fast and get big. It's no surprise that many Minnesota waters are producing lots of big muskies now. The switch from Shoepack to LCO and then Leech Lake muskellunge in Minnesota's stocking program 19-24 years ago is paying big dividends as the LCO and Leech Lake fish reach their prime, especially in lakes that had very few muskellunge originally, like Vermilion. We hope these examples cause musky anglers to question whether this is all simply about "the fish" (genetics).

So what makes it a bad idea to introduce non-native Mississippi strain fish into Lac Courte Oreilles if Minnesota introduced non-native Wisconsin fish into Mille Lacs? To answer that question, we must first remind everyone that our MDNR colleagues stocked LCO fish during 1982-1987 only because they were under extreme pressure to stop stocking Shoepack fish, and they had not yet developed the broodstock lakes they would need for large scale propagation of the Mississippi strain fish from Leech Lake. If problems arise because of mixing Shoepack with Wisconsin and Mississippi strain fish in Mille Lacs, negative effects may not be detected for a couple generations. Performance problems could include decreased natural reproduction, disease resistance, growth rate, or longevity. These symptoms of "outbreeding depression" could occur if any of the strains actually had a "coadapted gene complex" (please see Glossary) that could get destroyed when their hybrid grandchildren spawn with each other in the wild. We don't know if such a grouping of genes exists in muskellunge, so there is no guarantee of outbreeding depression. But the risk is real because we have seen it in largemouth bass and Pacific salmon.

Aside from the absence of clear evidence of superior MS strain performance, the legitimate fear of outbreeding depression is the main reason we will not permit the stocking of Mississippi strain muskies from Leech Lake into the historic native range of muskellunge in northern Wisconsin. In Lac Courte Oreilles, specifically, we will try to restore natural reproduction and recruitment of muskellunge. We will support the restoration of muskellunge spawning habitat in Musky Bay. We will take reasonable steps to reduce the pike population. We will try innovative stocking strategies. We are trying to apply what we have learned from past human mistakes. We will employ the scientific method and resist the temptation to do expedient or popular things without sufficient knowledge or justification. Repeating the ecological "sins of the past" by committing them with new and creative excuses will not help.

**Question #3 to DNR:** When northern pike invade native musky waters, we know those pike wreak havoc on the native muskies. In light of the fact that the DNR has known about the northern pike invasion problem for over 55 years, and have watched them advance, does the DNR have a plan – a definitive plan – in place to deal with the massive number of native musky lakes here that have been invaded by northern pike? Follow up: Why is there a bag limit on northern pike in waters like the Chippewa Flowage where their numbers have exploded?

**DNR Response to Question #3:** Actually, northern pike don't always wreak havoc upon native muskellunge, but they do in certain types of waters. So if the question is whether we have a comprehensive plan aimed at eradicating or controlling northern pike throughout the Upper Chippewa Basin, the answer is no. But we do have individual lake management plans under development that will address northern pike on a lake-by-lake basis. In some cases, pike will be viewed as an asset to be managed for their sport fishery value (for example, Nelson Lake in Sawyer County and Miller Dam Flowage in Taylor County). In other waters where muskellunge are high-priority species (Lac Courte Oreilles and the Chippewa Flowage), habitat restoration, water level management, adult muskellunge stock transfers, liberalized pike and bass regulations, and harvest promotions for northern pike and largemouth bass are potential strategies to reduce the significant impact of these predators on reproductive survival of young muskellunge. Last summer we promised to have those plans completed by June 30, 2006. We still hope to meet that deadline.

Please see our Response to Question #11 as one specific example of a strategy that may help tip the balance in favor of muskellunge over northern pike at Lac Courte Oreilles.

**Question #4 to WMRP:** Every time the topic of comparing the muskies from Minnesota to Wisconsin comes along, it seems to get wrapped up in this comparing of apples to oranges because of size structure or something with the lakes. If you take the big lakes out of the picture – take Mille Lacs, Vermilion, Leech Lake... some of these other big lakes – and stick the lakes from Cass Lake (which is roughly the size as the Chippewa Flowage) on down, and compare those lakes – the production of fish in those lakes – to Wisconsin, and also touch on forage. Because... have you come across, in your research, lakes in Minnesota of equal size to lakes in Wisconsin where the "Mississippi strain" has not performed well? And also include in that, not specifically talking about lakes that are rich in ciscoes or something like that – we don't see much of that in this State – but based more on the lakes with suckers, perch, carp – that type of forage.

**DNR Response to Question #4:** We would like to clarify that we do not believe lake size is a major determinant of the biological potential of muskellunge to grow large, though small lake size may significantly increase vulnerability to harvest by casual musky anglers. We are aware that muskellunge of various strains have grown fast and gotten big in lakes of only a few hundred acres. For muskellunge with the genetic potential to become large (like Leech Lake and LCO strains), the maximum density of trophy fish a lake can support is determined mostly by lake fertility; the number and size of preferred prey; and the rates of mortality, whether natural (disease and old age), accidental (swallowed live bait or spear wounds), or intentional (harvest by anglers or tribal spearers for food or trophy mounts). That said, total acreage of musky habitat is important in determining how many muskies, and therefore how many trophy muskies, can be produced on a statewide scale. Minnesota has far fewer musky waters than Wisconsin, but some of them are huge. Leech Lake alone covers almost as much area as all Class 1A musky waters in the State of Wisconsin combined. Because of the acreage disparity, Minnesota should produce more muskies and more trophy muskies than Wisconsin. Replacing Shoepack fish with Wisconsin fish and then Leech Lake fish has allowed Minnesota waters to achieve their full potential.

There are many other differences between the Minnesota and Wisconsin musky fisheries, making it difficult to compare “apples to apples” as suggested by the gentleman who asked this question. For a quick tabular summary of the differences we perceive between Minnesota and Wisconsin musky fisheries, please see Table 1 at the end of this document. The stocking of Wisconsin fish and then Leech Lake strain muskellunge 19-24 years ago in Minnesota tops the list. We believe this is responsible for making Minnesota the “go-to place” for trophy musky hunters today. Fast-growing fish of new strains stocked into lakes they did not previously inhabit are now coming of age (and size). In order to understand the significance of this factor, we need only to look at Leech Lake itself, which is not among the “hot new trophy waters” in Minnesota but has a very fine, long-established musky fishery.

We thought it would be interesting to compare the number of trophy muskellunge reported in the Muskies, Inc. “Lunge Log” in 111,527-acre Leech Lake with the number reported in 118,173 acres of Class 1A musky waters in Wisconsin since 1970. This is an apples-to-apples comparison of an approximately equal acreage of trophy musky water where the fisheries have been established for decades. Here are the average number of fish over 50 inches long that were reported as caught (and mostly released) by participating Muskies, Inc. members since 1970:

Leech Lake, MN averaged 4 muskies >50"/year during 1970-2005 (134 fish in 35 years).  
Wisconsin Class 1A musky waters averaged 4 muskies >50"/year during 1970-1990.  
Wisconsin Class 1A musky waters averaged 9 muskies >50"/year during 1990-2003.

So here in the cradle of the Leech Lake strain muskellunge, Lunge Log data cited frequently by the WMRP Team reveal no more trophy muskies reported caught by Muskies, Inc. members on an average annual basis than in a roughly equivalent acreage of Class 1A Trophy Musky Waters in the State of Wisconsin. In fact, there have been fewer than half as many reported from Leech Lake since 1990. If Leech Lake itself cannot match the per-acre catch of trophy fish reported from Wisconsin waters, how can this issue be all about genetics? Leech Lake has a very fine musky fishery, just like Wisconsin. As in Wisconsin’s Class 1A waters, the Leech Lake fishery is long established. Comparing the performance of long-established fisheries in Wisconsin (or Minnesota) against the new fisheries created when Shoepack fish were replaced ultimately by Leech Lake fish in most Minnesota waters is not comparing apples to apples.

Those who wish to know what a Wisconsin hatchery product will do when stocked into a relatively new, forage-rich environment (similar to the new Minnesota fisheries) need only to examine the recent history of 939-acre Rice Lake in Barron County. Rice Lake was drawn down to the level of a shallow marsh for dam repairs in the early 1980s. Upon refilling, it was stocked with 939,000 northern pike fry in 1984. In 1987 it received its first re-stocking of muskellunge – 1,400 fingerlings 9 inches long from the Spooner Hatchery. That year, 4 quarts of eggs came from Lac Courte Oreilles and 18.5 quarts came from Bone Lake (no mixing with fish from Woodruff Hatchery or elsewhere that year). So the entire first batch of muskies re-stocked into Rice Lake in 1987 had to come originally from either LCO or Bone Lake. From 1988 to 1991 the Spooner Hatchery stocked 1,400 muskellunge annually, and there have been various stockings since that time.

According to WDNR fishery biologist Heath Benike, a netting survey was conducted on Rice Lake in spring of 1994. At that time, the musky population was one of low density; and the fish ranged in length from 12.5 to 40.0 inches long. Males and females from the original 1987 year class averaged 39.2 inches long after only seven full growing seasons – above average growth rate for northwestern Wisconsin lakes. Apparently those fish have continued to grow well, because many are now being harvested and taken to a local taxidermist at lengths of 50 inches and longer. This is no surprise, because Rice Lake is rich in nutrients and has 23 species of forage fish, of which redhorse and white sucker are plentiful.

So here are some LCO/Bone Lake fish, growing fast and getting big, just like many of the recently revived or newly created musky fisheries in productive Minnesota lakes – another apples-to-apples comparison. Word must be spreading about the Rice Lake musky fishery, because the Wisconsin Musky Tour plans to hold a major outing there on June 10, 2006.

**Question #5 to BOTH:** [This question included a long statement that was difficult to follow on tape and has been paraphrased to the best of our ability as follows.] Neither side has talked about the disease – the pathology – of fish with rapid growth rates. Are they susceptible to premature death? Also, should eggs even be taken from big old fish that may have poor ovarian egg quality?

**DNR Response to Question #5:** We don't understand the physiological mechanisms, but experience has shown that fish with exceptionally fast growth rates rarely exhibit great longevity. By examining growth rings on the cleithrum bone of harvested trophy muskellunge, Dr. Ed Crossman and Dr. John Casselman of the Royal Ontario Museum were the first to recognize that the largest muskellunge of record in North America were not fish that had grown exceptionally fast, but rather fish that had grown at a moderate rate and lived a very long time. That life history pattern seems to characterize Wisconsin muskellunge.

In general, egg viability (hatching success) begins to decline as female fish near the end of their lives. But there is probably nothing wrong with the eggs that are fertilized, so we do not worry about poor offspring performance associated with eggs from large, old fish. In fact, we believe it is important to collect eggs from fish of all available sizes and ages throughout the two-week primary spawning season in order to maximize genetic diversity. Our recent attempt to identify several broodstock lakes with natural reproduction and eventually rotate among them on a five-year basis is another way to maximize genetic diversity.

**Question #6 to DNR:** With all due respect, I think the evidence is overwhelming that Leech Lake strain from the Upper Mississippi in Minnesota do grow faster, and do get bigger. Post and Strand did a study in 82 which caused a [stretch?] for the DNR. It emphasized the difference in the spawning characteristics, offshore, which makes it less susceptible to northern pike depredation. And my question to you is, since I did work up the guide survey and demonstrated the loss – that the guide loses 20 days – [next line inaudible on tape] – and it comes to \$3.4 million dollars out of this county... Why can't you just give it a chance now, and do your study here, and bring Leech Lake fish – the known quantity for a trophy class fishery – into 5 selected lakes? And if you put it in dollars, you could buy these fish, 500 to go in Lac Courte Oreilles, 350 to go in Round, Grindstone, and Whitefish -- and you could probably do that for \$30,000 – and you've got a chance to bring \$3.4 million dollars back to this community. What's the problem?

**DNR Response to Question #6:** To address the opening comment, Leech Lake fish may grow faster in Minnesota lakes than LCO fish grow in some Wisconsin lakes because of differences in fertility, preferred prey availability, and other factors. But the largest Minnesota fish have not approached the size of the largest Wisconsin fish. Even if one does not accept the current world record, there are several documented Wisconsin muskellunge larger than the 54-pound fish that has been the Minnesota State Record since 1952. Though length seems to matter more than weight to the majority of musky anglers who practice catch-and-release, weight is still the critical measure by which the musky fishing community judges its record fish.

Actually, the 1982 study was conducted by Dr. Douglas Post and Dr. William LeGrande from the University of Wisconsin at Stevens Point; it did not involve Bob Strand of the Minnesota DNR. The 1982 study was one of the earliest attempts to understand muskellunge genetics in the Midwest. It had nothing to do with spawning site selection. Post and LeGrande closely examined the DNA that codes for four enzyme systems, but found that only one of those enzyme-coding genes (LDH) was polymorphic (existed in different forms) and therefore could be used to test for any differences among muskellunge stocks. Based upon that single gene (one of millions in the muskellunge genome), Post and LeGrande grouped Leech and Lac Courte Oreilles fish together (found no differences in LDH allele frequencies); and they lumped Squirrel, Minocqua and Shoepack fish together. They understood the extreme limitations of their data, and their report concluded, "In terms of growth biology, genetic differences observed at this time do not clearly indicate a genetic basis for a slow growth rate in certain muskellunge populations." Their pioneering genetic work was interesting, but very limited; and it was never published in a peer-reviewed scientific journal. Based upon this study, fishery scientists have virtually no reason to believe that muskies from Squirrel or Minocqua lakes in Wisconsin are genetically similar to the slow-growing strain from Shoepack Lake, Minnesota.

Perhaps this question was actually in reference to the excellent telemetry study conducted by MDNR biologist Bob Strand in 1979. Bob put radio tags in 14 muskies (all under 48 inches long) in Leech Lake, Minnesota and documented the movement of 12 fish for more than a year. He found six large primary spawning areas where tracked muskellunge spawned away from the shoreline over dense mats of stonewort (*Chara*) 6-12 inches thick at depths of 3-6 feet where the substrate was comprised of soft, flocculent marl – a calcium-rich substrate high in dissolved oxygen that favors the survival and hatching of musky eggs. If Leech Lake and others in north central Minnesota did not have such high alkalinity (typically 140-150 ppm) and high calcium content, stonewort would not grow in such abundance and the muskies might spawn elsewhere.

This “off-shore spawning tendency” of Leech Lake muskellunge, in the end, may be nothing more than a preference for a particular spawning substrate (stonewort over marl) wherever it may occur, which in Leech Lake is some distance away from the shoreline. Leech Lake muskellunge stocked into lakes low in alkalinity and calcium (most northern Wisconsin waters) would not encounter dense mats of stonewort and might therefore choose to spawn in traditional near-shore areas over well-oxygenated substrates.

In any event, the supposed ability of Mississippi strain fish to co-exist better with northern pike because of an alleged genetic predisposition to spawn away from near-shore spawning pike has not been proven and cannot form the basis of a policy decision to stock Leech Lake fish outside their native range. At the recent Crossman Muskellunge Symposium in Indianapolis, Indiana, Dr. James Diana of the University of Michigan at Ann Arbor stated in a panel discussion, “I don’t think there is any evidence we have to say that a strain that is comfortable in a location where both pike and muskellunge exist, will have any better capability surviving in the long-run in a new situation with pike. I think that we need better research on that coexistence and what causes one or the other to become dominant, but at this point we really don’t know, and I don’t think you can say that the Leech Lake strain will be any better in an inland lake in dealing with pike as a competitor than would the Wisconsin strain.”

A study done in 1989 (published in 1996) in Point Marguerite Marsh in Alexandria Bay on the upper St. Lawrence River by John Farrell and other New York researchers showed that muskies spawned shallow as expected, but that pike actually spawned deep (opposite the norm). Water level fluctuations had created firm, oxygen-rich substrates near shore (preferred musky spawning habitat), restricting growth of submergent vegetation (good pike spawning habitat, even over mucky substrate) to a greater depth and distance away from shore. For all we know, this could be happening on waters like the Chippewa Flowage. An excellent analysis of this subject by Mike Dombeck and his advisors at Iowa State University in 1986 showed that rising spring water level in Wisconsin and Minnesota flowages was one of the most significant factors associated with successful muskellunge reproduction in lakes with northern pike. They also found that human shoreland development had negative impacts on musky reproduction. Habitat matters.

Regarding economic losses, we wonder what an independent professional economist would say about calculating county-wide economic losses based upon an estimated decrease in one activity (guided trips for trophy muskellunge) without examining what, if any, income-producing activities may have increased as a result of concurrent changes in local fishing opportunity. For example, might there have been a compensatory increase in unguided trips by people who are thrilled to catch 40-inch muskies, which are now more numerous than ever in Sawyer County? Aren’t those average musky anglers spending money at local resorts, bait shops, restaurants and gas stations too? Did anyone try to measure their increased contribution, if any, to the area economy? In response to a posted concern about Chippewa Flowage resorts by a visitor to Pastika’s web forum on 2/27/06, a well-known local fishing guide, resort owner, and outdoor radio talk show host replied, “Actually the resort business is doing quite well in the Hayward area with very few exceptions and most resorts are or will be booked up by the end of March.”



On November 9, 2005, over 100 local business and community leaders attended the Sawyer County Economic Summit at the LCO Convention Center. Local WDNR Fisheries Supervisor Dave Neuswanger attended that conference. Lake water quality was a top concern. But the loss of fishing-related tourism income was neither perceived nor discussed. Unless claims can be supported by an independent professional economist, we are not prepared to believe that Sawyer County has suffered a net loss of \$3.4 million dollars annually because of bad musky fishing.

We sympathize with folks who guide for a living and have temporarily lost a portion of their trophy-seeking clientele. The same thing has happened around Leech Lake itself (a long-established musky fishery, like ours in Wisconsin). But nobody has claimed that the Leech Lake muskellunge population has lost its genetic fitness. Minnesota anglers seem to recognize that the movement away from Leech Lake is simply a predictable response to the outstanding fishing that has developed elsewhere since Shoepack fish were replaced with Wisconsin fish and then Leech Lake fish as the source for stocking most Minnesota waters 19-24 years ago. According to Jerry Younk of the Minnesota DNR, one purpose of expanding Minnesota's musky program in the 1980s was to reduce excessive fishing pressure on Leech Lake. Their strategy may have worked a little too well. But it may be possible for Sawyer County and Leech Lake tourism officials to bring back some trophy musky hunters. In Wisconsin, we could start by informing visitors that fishery scientists everywhere agree there is no solid evidence of genetically-based performance problems. Also, all stakeholders could support more effective regulations on the pursuit and harvest of muskellunge (see Response to Question #15). WDNR would welcome the opportunity to help the Hayward Visitors and Convention Bureau develop accurate information for visitors to Sawyer County.

To answer the actual question, the problem is that we don't believe the data interpretations or accept the assumptions behind the WMRP Team's proposal to stock a few Sawyer County lakes with non-native muskellunge. We believe muskies stocked into LCO will migrate downstream to the Chippewa River where native muskellunge reproduce naturally. Two fish geneticists, Dr. Jeffrey Koppelman and Dr. David Phillip, wrote a 1986 article entitled "Genetic Applications in Muskellunge Management" which concluded, "The introduction of a new stock into an established population of muskellunge would most likely disrupt selectively advantageous allele combinations and genic arrangements present in the recipient populations. This would probably result in a reduction in the fitness of the recipient population. Once specific allele combinations have been altered or lost, they will be difficult, if not impossible, to reconstruct."

**Question #7 to DNR:** Let's assume tomorrow you decide that stocking the "Mississippi strain" is a good idea. How long would it take to get the wheels in motion to accomplish that task? Who would you have to convince in your superiors?

**DNR Response to Question #7:** This question is extremely hypothetical, but we welcome the opportunity to explain that a major change in hatchery propagation cannot be made overnight. We cannot effectively manage two parallel programs on a large scale – one involving Leech Lake broodstock and another involving Wisconsin broodstock. Capturing broodstock from two strains and keeping their offspring separate in hatching jars, raceways, and ponds would be costly and fraught with the possibility of human error. More importantly, there seems to be little justification for modifying hatchery operations unless and until the upcoming seven-lake paired-stock study reveals that Leech Lake fish are clearly superior to Wisconsin fish in achieving musky fishery objectives in Wisconsin waters.

In addition to the paired stocking study, we would need the results of ongoing genetic stock research to determine where, if anywhere, muskellunge of the Mississippi strain could be stocked in the State of Wisconsin without endangering the integrity of native genetic stocks. If our studies suggest that Leech Lake fish should be stocked regularly in some Wisconsin waters, we will have to explore ways to produce or purchase those fish. A decision to stock the Mississippi strain widely outside the native range in Wisconsin would have to be recommended by the statewide Muskellunge Team and approved by the Fisheries Management Board, which is comprised of members of the Fisheries Management leadership team, including the Director of the Bureau of Fisheries Management.

**Question #8 to BOTH:** This appears to be a discussion of musky management for business and musky management for the environment. If this area respects and values muskies so much, wouldn't you want to be a little conservative on your decisions on musky management? Three things can happen when you change something: They can get worse; they can stay the same; or they can get better. Wouldn't the genetic study that's going to take a few more years to get done be a good push to do it, instead of just trying something and then something goes to heck in a handbag? It could happen.

**DNR Response to Question #8:** We agree. We promise to take a cautious, science-based approach to conserving genetic stocks that have produced record fish in Hayward area waters.

**Question #9 to DNR:** If the genetically mixed Wisconsin hatchery strain muskies or indeed the Chippewa Flowage strain were bested in side-by-side studies with Leech Lake "Mississippi strain" muskies, would we have a commitment then that the DNR would switch their policy and stock the Leech Lake strain muskellunge?

**DNR Response to Question #9:** We offer a direct answer to this question in our Response to Question #7. But we do not accept the basic premise of this question.

Wisconsin hatcheries often have mixed fish from different populations from within Wisconsin's native range. Were any of those populations distinct "strains" or genetic stocks with predictable performance differences? We are not certain. We don't know if a "Chippewa Flowage strain" exists. (Please see definitions in the Glossary of Terms attached to this document.) We need more than one study showing differential performance of offspring in two lakes (LCO and Mud/Callahan in Wisconsin Research Report 172 published in 1996) in order to arrive at such conclusions; and there must be supporting evidence based upon DNA analysis. The authors of Report 172, DNR researchers Terry Margenau and Dave Hanson, cautioned readers that, "Insufficient replication of stockings of different muskellunge populations in study lakes, and low numbers of adult muskellunge recaptured made data analysis and conclusions from this study limited and difficult."

Environmental factors and fish community dynamics have significant influence on musky performance. The degree to which the mixing of eggs for hatchery propagation has occurred does not guarantee a pervasive influence of slower-growing genetic stocks even if such stocks exist in Wisconsin. Experience at Rice Lake in Barron County suggests that Wisconsin hatchery fish originating from LCO and Bone Lake in 1987 could grow fast and get big in a forage-rich environment with an open niche for muskellunge (see Response to Question #4).

**Question #10 to DNR:** I have read where the State is reluctant to stock the “Mississippi strain” because it’s termed an exotic. But doesn’t the State have a history of already stocking exotics? (For example, in our area, we have trout in Round Lake.) And then, related to that, if you don’t want to mix the exotics, aren’t there some lakes in Sawyer County that are isolated enough so that fish can be stocked and progress can be seen without mixing with others?

**DNR Response to Question #10:** Though we have never referred to Mississippi strain muskellunge as an exotic species, we have indicated they would be classified as an exotic strain if stocked into Sawyer County waters. Some folks object to our use of the term “exotic” to describe these fish. Past studies reveal physiological distinctions between Wisconsin muskellunge and Mississippi strain muskellunge from Leech Lake, Minnesota. Distinguishing physiological features include observed differences in annual incremental growth in length and age at maturation. Mississippi strain muskellunge from Leech Lake do not exist currently in Sawyer County waters, and to our knowledge they never did. This, by any scientific definition, would make them an exotic strain if stocked here.

A common point of origin in the lower Mississippi River basin (as far south as Oklahoma) during the last period of glaciation does not mean muskellunge in Leech Lake, Minnesota are the same as those that were distributed throughout northern Wisconsin when Europeans arrived here. Many changes can and likely did occur over the course of 10,000 years since the ice receded, including the development of different strains and genetic stocks, either by chance or in response to selective pressures imposed by local conditions. But if folks are uncomfortable with the word “exotic” to describe the status of Mississippi strain muskellunge in Sawyer County, we will use the term “non-native” from this point onward. Management implications are the same.

In response to the first question, Wisconsin and every other state in the country have, at one time or another, stocked exotic or non-native species and strains of fish. Examples are too numerous to mention. Intentions were usually good, but recently biologists have become acutely aware of the ecosystem disruption and genetic stock damage caused by many of these introductions. The gentleman mentioned Round Lake, where a small but vocal group of lakeside landowners pressured WDNR into reducing the stocking of native muskellunge several years ago. Sawyer County Senior Fish Biologist Frank Pratt decided to experiment with the creation of a trout fishery at Round Lake, suspecting that post-stocking mortality of trout would be minimal if muskellunge density was low. Even though brown trout survived well and grew fast, we have learned that trout are not desired by a majority of local stakeholders, some of whom strongly resent the introduction of trout. We don’t believe trout have harmed anything, but all trout stocking in Round Lake will cease beginning in 2006. We will renew an emphasis on muskellunge management because we believe Round Lake can produce more muskies, and because that is the clear desire of a majority of local stakeholders in the Round Lake fishery.

In response to the second question, there are no waters in Sawyer County that are isolated enough to make us comfortable about importing a non-native strain of muskellunge to the area. Northern pike spread like wildfire once they got a foothold in the Upper Chippewa Basin. They spread naturally by migrating through our elaborate drainage systems; and they spread by bait bucket and live well. We will not endanger native muskellunge stocks by giving a non-native strain a foothold anywhere in the historic native range of muskellunge in northern Wisconsin, including Sawyer County. We have learned our lesson.

**Question #11 to DNR:** Is the potential transfer of adult muskies from Butternut Lake to Lac Courte Oreilles another potential disaster waiting to happen?

**DNR Response to Question #11:** Yes, the proposed stock transfer certainly could be a disaster. That's why we have stated in our management plans that we would not perform such a transfer if genetic testing reveals that the fish in Butternut Lake and LCO appear to be of different genetic stocks. We're guessing these fish will be very similar because they were stocked for many years with fish from common sources. If genetic analysis confirms that these populations are similar enough to minimize risk of outbreeding depression, then we see many advantages to implementing this project. It should be noted that Butternut Lake muskellunge have been reproducing naturally at a moderately high rate for the past several years, despite the presence of a significant population of northern pike. (The same is true of many Sawyer County waters.)

Butternut Lake was producing substantial catches of 50-inch muskies as recently as the mid 1990s, before density increased to a very high 1.0 adult fish per acre in 2003. That increase has resulted in reduced growth rate and sizes of muskellunge in Butternut Lake; and we have evidence that excessive musky predation has adversely affected other species in the fish community. Removing half the adult fish from Butternut Lake would be a good start in restoring balance to the fish community and improving muskellunge size structure to meet stakeholder-influenced objectives in the 2004 Fishery Management Plan (0.2-0.3 adult musky per acre with 25-50% of all catchable-size fish over 38 inches long).

Another reason for our conditional proposal to move 500 young adult muskellunge (28-38 inches long) from Butternut Lake to LCO is to begin tipping the esocid community balance in favor of muskellunge over northern pike at LCO. (We do not believe fingerling stocking alone will accomplish this.) The field-transfer project has two objectives for LCO: 1) Increase the density of adult muskellunge from 0.05/acre to 0.15/acre as soon as possible; and 2) Provide a large pool of marked fish (all those transferred) in order to facilitate accurate estimates of population density, growth rate, and harvest rate during future recapture surveys.

It is our sincere hope that LCO Tribe members will embrace this transfer of muskellunge from a lake they do not usually spear to one they do. If the transfer proceeds, we will encourage our tribal neighbors to harvest from this resource and also to report, voluntarily, their harvest of marked and unmarked fish as a check on our netting-based estimates of population density. Good information is vital to management for all interests.

**Question #12 to DNR:** As someone that has taken eggs in Minnesota with the DNR, and also guided in Wisconsin, one thing I did see is that they [MDNR] stocked more extended growth 30-inch size fish... [Words became inaudible on the tape here. The questioner later clarified his belief that fish are routinely being stocked at a length of 30 inches in Minnesota.] Everybody from Illinois and Indiana is coming up here to get that 48- to 50-inch class fish. And you showed in your own charts that the "Mississippi strain" fish got there faster. One of the things that nobody addressed here is that in 5 years that "Mississippi strain" will be able to spawn, whereas the Wisconsin, Lac Courte Oreilles strain is still at 30 inches – it's not a mature female. So you've got two years that you're going to have spawning two years in before that Wisconsin strain catches up. That's more money out of your own pocket, right? [The questioner also commented in follow-up that many of the trophy fish being caught in Mille Lacs are Wisconsin strain – that the two strains work together.]

**DNR Response to Question #12:** This question seems to imply that Minnesota routinely stocks 30-inch muskellunge. That is not the case. Perhaps this idea arose from a couple special projects near the Twin Cities where local musky club members raised some large fingerlings to sub-adult size in rearing ponds that could be drained into nearby waters. But in general, the Minnesota DNR stocks 10-12 inch hatchery-reared muskellunge, just like Wisconsin. WDNR has evaluated the cost-effectiveness of stocking 14-inch spring yearlings and 20-inch fall yearlings. It is not economically feasible for either state to stock large fish on a routine basis. It may be possible in special situations to produce larger yearlings for stocking, or to field-transfer small adult muskies from one overcrowded population (for example, Butternut Lake) to a lake that needs a boost in adult muskellunge in order to overcome pike dominance (for example, LCO) if the genetic stocks are compatible.

**Question #13 to DNR:** Earlier you were basically talking about what sounded like risk of stocking “Mississippi strain” muskies in this general area. We’re talking about lakes that have no natural reproduction and must be stocked, and all waters connected to or from have no natural reproduction and must be stocked. To me that tells me there’s no risk. And the second part of this would be, do you know of any single one-time case documented of, I believe you call it outbreeding depression among muskies? What’s the risk at a lake like LCO (where there’s no natural reproduction)?

**DNR Response to Question #13:** No, there has never been a single case of outbreeding depression documented in muskellunge. Likewise, there has never been a single case of outbreeding depression documented in walleye, crappie, bluegill, northern pike, or most other fish species. It has been documented in largemouth bass, and it has been documented frequently in trout and salmon. This genetic problem is difficult to document. But absence of evidence should not be interpreted as evidence of absence. Outbreeding depression has been documented for largemouth bass and salmonids because fish geneticists have studied those species more than others. Outbreeding depression is a well-known, well-accepted phenomenon among people who study fish population genetics (see Response to Question #2.) It probably happens frequently without recognition.

The risk of stocking a lake like LCO, in which muskellunge currently fail to undergo natural recruitment, was addressed in the last paragraph of our Response to Question #6.

**Question #14 to BOTH:** When the difficulties with the musky fishery in Minnesota were recognized, they were recognized in a few short months time. And with that knowledge and the scientific facts that were already in place, from the studies that I read, why is it the same cannot be done here in Sawyer County without spending a whole bunch more money to produce more studies when it’s already been studied into the ground?

**DNR Response to Question #14:** This seems to be a restatement of Question #1, so we ask our readers to refer to our Response to Question #1 for the answer. One short-term, paired-stocking study on one Minnesota lake where neither strain’s performance was clearly superior hardly constitutes “studying this into the ground.” It must be emphasized that WDNR’s decision to exclude non-native strains applies to the entire historic native range of muskellunge in the Northern Region of Wisconsin, not just to Sawyer County. That said, we assure everyone that local DNR fisheries staff fully support the statewide agency position on this issue. In fact, they helped formulate that position.

**Question #15 to DNR:** You talk about working with “tweaking” what we’ve got here today, whatever that may be, because of all the stuff that’s out there. And in your presentation you talked about single-hook rigs, and Larry said that you can’t even buy single-hook rigs. But let’s face it, they can go and buy the components. And I’m from down in the Chippewa Falls area, and we know that there’s still some eating and harvesting going on, and there will be. But if you’re talking about that and you’re talking about size limits to do that, if you want to work with what’s here; does the DNR have a plan that circumvents the Conservation Congress that will bring what the anglers want – not only in Wisconsin, but anglers from outside of the State – that can help support the businesses of the people that are here and a lot of my friends and colleagues that guide full-time in the area.... Are you going to tweak what’s here biologically... are you going to use... can you put regulations in place – not look at it, but put it in place immediately – on the lakes that you believe have the potential? [Then a long statement about Lake Namekagon without a question.] What about regulations that can be enforced that could maybe show some improvement for the people in this area in the meantime while you look at Leech Lake fish in other areas?

**DNR Response to Question #15:** We cannot legally circumvent the process for enacting or changing fishing regulations via the Wisconsin Conservation Congress. We appreciate and even share angler frustration that regulation changes take so much time and paperwork to implement. Revamping the statewide process would require a grassroots angler initiative and broad support. But regardless of process, we will need strong support from musky anglers and others in order to implement effective musky angling regulations designed to increase the number of trophy-sized fish in Wisconsin. Examples include gear restrictions (particularly with respect to live bait), high minimum length limits, and maybe even slot length limits designed to increase “turnover rate” by promoting selective harvest of some abundant, slower-growing fish (more likely to be males) in high-density musky populations. To date, support for such measures has been insufficient to bring about major change. When higher minimum length limits were proposed for several suitable waters at the 2005 spring hearings of the Wisconsin Conservation Congress, participants voted heavily against the DNR initiative. We will need much help and support in order to make progress with regulatory strategies.

**Table 1.**  
**Select Differences between Minnesota and Wisconsin**  
**Muskellunge Fisheries**

<b>Minnesota</b>	<b>Wisconsin</b>
Leech Lake Strain Stocked Statewide Starting 19-24 Years Ago (New Fish in New Environments)	Northern Wisconsin Mix Stocked Statewide for Several Decades (Long Established Fisheries)
High Alkalinity in Most Managed Waters (140 – 150 ppm) Linked to Overall Productivity	Low Alkalinity in Most Managed Waters (30 – 50 ppm) Linked to Overall Productivity
Some Very Large Managed Waters --Mille Lacs, Cass, Leech, Vermilion-- (Spacial Refuge from Casual Anglers?)	Largest Wisconsin Lakes Much Smaller Than Many Minnesota Lakes (Increased Vulnerability to Harvest?)
Ciscoes (prey) in Most Big Trophy Waters	Ciscoes (prey) in Some Class 1A Waters
Very Low Tribal Harvest (16 muskies, only on Mille Lacs, during 1999/2000)	Low Tribal Harvest Off-Reservation Unknown Tribal Harvest On-Reservation Unknown Winter Tribal Harvest
40" Statewide Minimum Length Limit	34" Statewide Minimum Length Limit
Only 1 Line Allowed (cast a lure or fish a sucker, but not both)	Two Lines Allowed (drag a sucker and cast a lure at same time)
Only 1 Lure or 1 Hook Allowed (no treble hooks allowed on live-bait rigs)	Multiple Hooks Allowed (including treble hooks on live bait rigs)
Very Little Sucker Fishing Tradition	Well Established Sucker Fishing Tradition
Motor Trolling Allowed Statewide	Motor Trolling Prohibited on Many Waters
Sport Spearing Season for Northern Pike	Ice Spearing of Northern Pike Limited to Lake Superior

## Glossary of Terms

**Alkalinity** – often described as the “buffering capacity” of a body of water, it reflects how much acid could be added to a lake before pH would drop to levels intolerable to aquatic life. Alkalinity is usually highly correlated to the amount of calcium dissolved in the water, and it is sometimes used as an indirect indicator of the overall capacity of a body of water to produce fish.

**Allele** – an alternative form of a gene that differs from other alleles in its DNA sequence or in its actual effect on the observable characteristics of an organism.

**Broodstock** – adult fish used as a source of eggs for the production of young fish at a hatchery.

**Coadapted Gene Complex** – a favorable combination of alleles that arises by chance and becomes widespread in populations when the encoded traits are advantageous for survival and reproduction.

**Cleithrum** – an elongated bony structure that lies posterior to the gill cover of muskellunge. Biologists can determine the age of old muskellunge with reasonable accuracy by counting the growth rings on extracted cleithra.

**Community (Fish)** – all the populations of all the fish species in a particular body of water.

**Condition** – a general term used to refer to the relative plumpness of a fish, measured by its weight in relation to its length. A robust fish is said to be in good condition.

**Conservation** – preservation and wise use of natural resources.

**Density** – the number of fish estimated to exist (not actually counted) in a specified area of water. Density of muskellunge is expressed as number of adult fish per acre. In Wisconsin, fish captured in fyke nets one spring are marked, and the proportion of those marked fish recaptured during the following spring is used to estimate population density. Wisconsin DNR estimates muskellunge density routinely on lakes within the Ceded Territory. Minnesota DNR does not.

**Dissolved Oxygen** – The amount of pure oxygen gas that is actually dissolved in water. This is not the “O” in “H<sub>2</sub>O” as is commonly misunderstood. It is the amount of O<sub>2</sub> gas available for the respiration of fish eggs, fish, and other aerobic (oxygen-breathing) aquatic organisms. Microscopic algae and visible aquatic plants produce most of the dissolved oxygen in a lake.

**DNA** – deoxyribonucleic acid, the molecule that encodes genetic information needed for normal development, maintenance, and reproduction of an organism.

**Enzyme** – a type of protein molecule that serves as a catalyst to convert one biologically active chemical to another.



**Fertility (Productivity)** – the potential of a body of water for biological production, usually determined by the nutrient in most limited supply, which in our case is phosphorus. In general, increases in phosphorus concentration result in increased microscopic algae, animal plankton, small fish that feed upon the plankton, and large fish that feed upon the small fish. Lakes with high fertility may be perceived as having water quality problems (low visibility in green water), but are capable of producing more pounds of fish and other aquatic organisms than clear lakes with low fertility.

**Fingerlings** – young fish reared at a hatchery beyond the fry (recently hatched) stage. Muskellunge fingerlings can range in size from 2 to 14 inches. In Wisconsin, musky fingerlings typically are stocked in the fall at lengths of 10 to 12 inches.

**Fishery** – as defined by Robert Lackey and his colleagues at Virginia Polytechnic Institute, a fishery is the complex interaction among components of an aquatic ecosystem (including fish, habitat, and other aquatic organisms) and their utilization by mankind.

**Fish Stock** – a group of fish (of the same species) that share the same demographic parameters. For example, all the muskellunge that live and breed in lakes and streams of the Chippewa River Basin might be considered a stock. A stock can be comprised of numerous populations and subpopulations, and therefore can be highly variable within the overall demographic area that forms the stock boundary.

**Fitness** – the ability to survive to reproductive age and leave viable offspring.

**Forage** – the type and amount of prey (usually fish) available for predators like muskies to eat.

**Gene** – a hereditary unit that occupies a specific location on a chromosome, the physical entity that is transmitted from parent to offspring. Often, the term “gene” is used to refer to a unit that contains the code for the biochemical manufacture of a specific trait or protein.

**Genetics** – the scientific study of inheritance.

**Genetic Stock** – a group of organisms sharing a gene pool that is sufficiently discrete and nominally identifiable that it warrants management as such. A genetic stock is so distinct that we can easily distinguish it from others and should manage it assuming that those genetic differences may affect performance as well. Totally random breeding occurs within genetic stocks but not between genetic stocks. What’s the implication? There may be one or there may be dozens of genetic stocks in the various lakes and rivers of the Upper Chippewa River Basin. Only modern genetic testing and ecological studies can tell us if there are “sufficiently discrete and nominally identifiable” groups that perform differently enough to warrant special management consideration.

**Growth Rate** – the amount of body mass gained over a specified period of time. In fish, growth rate is most conveniently described as the annual increase in length. It can be measured directly by capturing and recapturing marked fish from one year to the next. But usually growth rate is estimated by examining the distance between “growth rings” that appear on bony structures such as fish scales, or, in the case of adult muskellunge, the cleithrum bone. Biologists have learned recently that the scale method is unreliable for purposes of aging muskellunge accurately beyond the first 4-5 years, so many previously published estimates of growth rate based upon scale analyses probably contain serious errors. Accurate estimates of age and growth for adult muskellunge must be obtained by examining the cleithrum bone, which unfortunately requires killing the fish. WDNR biologists in the Upper Chippewa Basin do not intentionally sacrifice muskellunge for the purpose of determining their age.

**Harvest** – the catching and keeping of fish, either for consumption or trophy mounts.

**Hybrid** – the offspring of two animals or plants of different races, breeds, varieties, or species.

**LDH** – lactate dehydrogenase, a globular protein enzyme that transfers electrons from lactate to the oxidized form of the coenzyme nicotinamide adenine dinucleotide,  $\text{NAD}^+$ , to yield pyruvate, the reduced coenzyme NADH, and a proton. This is the single enzyme encoded by the single polymorphic gene that Post and LeGrande tested for differences in allele frequency among Wisconsin and Minnesota musky populations in 1982.

**Longevity** – length or duration of life, usually expressed in years. Muskellunge rarely live longer than 30 years, and longevity may vary among strains.

**Mortality Rate** – death rate, usually expressed for fish as the proportion (%) of some age group that dies during a specified time period. According to a study in the early 1980s by WDNR researcher Dave Hansen, the post-stocking mortality rate of 10- to 12-inch musky fingerlings from September to November averaged 61% in 8 northern Wisconsin lakes. The average annual mortality rate of any given age group of muskellunge in Lac Courte Oreilles was estimated to be 30% during 1961-1977 by WDNR researchers John Lyons and Terry Margenau (WDNR Technical Bulletin 160).

**Native Range** – the geographical area occupied by a particular species or strain before European settlers captured and moved those species or strains to new areas.

**Niche** – an organism’s role in the ecosystem. For example, muskellunge often occupy the niche of “top predator” in Wisconsin lakes and rivers.

**Outbreeding Depression** – a reduction in fitness following mating between individuals from different genetic stocks of the same species. This can occur in the immediate hybrid but is more likely to occur in the backcross or subsequent generations.

**Performance** – a general term used to describe how well or poorly an individual fish, strain, or genetic stock is surviving, growing, and reproducing in a given body of water.

**Polymorphic Gene** – a gene that can exist in different forms called alleles.

**Population** – a group of organisms belonging to the same species that freely interbreed. For example, if all 800 adult muskies (just a “guestimate”) in 1,620-acre Moose Lake freely interbreed (spawning at overlapping times and places at least once every few years), then they would all be considered members of the Moose Lake musky population. Geneticists have developed a "coefficient of relatedness" to statistically determine relationships (types and degrees of similarity) within and between populations.

**Progeny** – offspring or descendants.

**Propagation** – the art and science of culturing healthy fish in a hatchery environment in order to provide stocked fish, where needed, to meet fishery management goals.

**Recruitment** – the number of young fish entering the fishable stock, defined specifically for muskellunge as the number of young fish that survive long enough to reach a defined “stock size” of 20 inches (has nothing to do with size at stocking). Recruitment can be natural if resulting from natural reproduction, or it can be artificial if resulting from stocking. Once a fish has been “recruited to stock size” its chances of being eaten by larger fish are reduced, and it is likely to become available to anglers within the next couple years if it does not die from disease or accident.

**Reproduction (Natural)** – the act of spawning successfully in the wild; but also a term used by fishery biologists to measure the survival of young fish to the end of their first growing season in the wild. In muskellunge, natural reproduction is indexed by the capture rate of muskies hatched that year per mile of shoreline sampled with an electrofishing boat at night in September. Young muskellunge present in a lake as a result of natural reproduction often can be distinguished from those reared in a hatchery because the hatchery-produced fish are usually a couple inches longer.

**Size Structure** – the relative proportion of fish of different sizes in a population. Muskellunge size structure can be expressed by using the Relative Stock Density (RSD) index, calculated by dividing the number of fish over a specified size by the total number of “stock-size” muskellunge (those 20 inches or longer) in a sample. For example, if 5% of all muskellunge over 20 inches long in a sampled population are 50 inches or longer, then RSD-50 would be 5%.

**Stonewort** – the common name for a macrophytic genus of algae known as *Chara* that grows near the bottom of lakes rich in calcium, like many of the lakes in north central Minnesota.

**Strain** – according to Webster's dictionary (used by fish geneticists), a strain is "a group of presumed common ancestry with clear-cut physiological but usually not morphological distinctions." The word "strain" is used (and misused) commonly in daily conversation and popular literature. The word "strain" is rarely used by population geneticists when they talk among themselves. It is not clearly defined in their specialty literature. We can only surmise the reason for this lack of definition and frequent usage is that population geneticists have more specific terms for describing groups of organisms, like population, subpopulation, stock, and genetic stock.

**Submergent Vegetation** – aquatic plants that exist entirely below the water's surface.

**Subpopulations** – breeding groups within a large population between which migration is significantly restricted. For example, if we were to learn one day that one breeding group of 200 adult muskies in Moose Lake always swims far upstream to spawn in the West Fork of the Chippewa River, while another breeding group of 600 spawns only in the impounded portion of Moose Lake, with little or no mixing between those groups during any given spawning season, we would say there were two subpopulations. They may or may not be genetically distinguishable, but given enough time (several generations, centuries, or millennia) they are likely to "diverge" and become genetic stocks.

**Telemetry** – a method for tracking the movement of wild animals, including fish, by monitoring their location with a radio receiver that is capable of detecting specific radio frequencies emitted by implanted transmitters.

**Trophy Muskellunge** – generally accepted by fishery biologists and anglers alike as a fish that is at least 50 inches long. However, trophies, like beauty, are in the eyes of the beholder. According to Dr. John Casselman at the 2006 Crossman Musky Symposium, an improved system for determining trophy size might be to express it as a proportion of the maximum size attainable in each individual lake or drainage system, knowing that these systems vary in their productivity, availability of preferred prey, genetic stock, and other factors.

**Yearling (Fish)** – a fish that has reached its first birthday, but not its second. In Wisconsin, yearling muskellunge typically start their second year of life at lengths of 8-12 inches and end it at lengths of 16-20 inches.

Respectfully submitted to the Hayward Visitors and Convention Bureau on March 16, 2005  
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